# Studies on the Freshwater Oligochaeta of South India

## I. Aeolosomatidae and Naididae

PART 4

BY

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(*With eight text-figures*)

[*Continued from Vol.* **59** (2) : 545]

### Subgenus **Aulophorus** Schmarda, 1861

*Subgeneric characters :* No eyes. Dorsal bundles with hairs and needles ; ventral setae of II-V distinct from the rest. Stomach present or absent ; intestinal anti-peristalsis and ascending ciliary vibration occur ; chloragogues from VI on. Coelomocytes present or absent. Branchial organ with non-contractile, avascular palps. Dorsal vessel contractile, ventrally to the left for the greater part, mid-dorsal in 5-6 anterior segments. Ventral vessel non-contractile and mid-ventral, divides posteriorly into 2, branches traverse the margin of the fossa supplying vascular loops to the gills ; loops on emerging from the gills unite to form dorsal vessel. Contractile lateral vessels connect the main vessels. Budding zones provide prostomium and 5 head segments to posterior zooid, and some hind segments and branchial organ to anterior zooid, before fission. Sperm-sac and ovi-sac, posterior diverticula of septa 5/6 and 6/7, former within latter, extend backward. Penial setae absent. Spermathecae a pair in V.

KEY TO ALL THE KNOWN AND VALID SPECIES OF *AULOPHORUS*

| | |
|---|---|
| A-1 Dorsal setae beginning in IV .. | **superterranus* |
| A-2 Dorsal setae beginning in V | |
| B-1 Needles bifid with intermediate teeth | |
| C-1 Intermediate teeth 2-4 between main teeth of needles ; 4 pairs of gills .. | **pectinatus* |
| C-2 One short intermediate tooth between main needle teeth ; 3 pairs of gills .. | *indicus* sp. nov. |
| B-2 Needles simply bifid without intermediate teeth | |

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D-1 Needle teeth of equal length ; with 4 pairs of gills .. **borellii*

D-2 Needle teeth of unequal length

E-1 Distal tooth thinner and shorter than proximal .. *furcatus*

E-2 Distal tooth thinner and longer than proximal

F-1 Hairs bayonet-shaped ; no coelomocytes ; 3 pairs of foliate gills .. *hymanae* sp. nov.

F-2 Hairs simple ; coelomocytes present ; 4 pairs of digitiform gills .. *michaelseni*

A-3 Dorsal setae beginning in VI

G-1 Needles simply bifid without intermediate teeth .. *gravelyi*

G-2 Needles bifid with intermediate teeth

H-1 Needles with minute short blunt intermediate teeth between main teeth without webbing ; 4 pairs of gills .. **beadlei*

H-2 Needles with short teeth with a concave intermediate webbing between main teeth ; 3 pairs of gills .. **caraibicus*

G-3 Needles palmate

I-1 Ventral setae of II-V more than twice as long as the rest .. **flabelliger*

I-2 Ventral setae of II-V twice or less as long as the rest

J-1 Web of the needle with ribs .. **huaronensis*

J-2 Web of needle without ribs

K-1 Needles with intermediate teeth .. **vagus*

K-2 Needles without intermediate teeth

L-1 Dorsal bundles with 1 hair and 1 needle .. **schmardai*

L-2 Dorsal bundles with 1-2 hairs and 1-2 needles

M-1 Needles 64-80 $\mu$ long ; branchial organ with 2 pairs of gills normally ; spermathecae absent .. *tonkinensis*

M-2 Needles 80-120 $\mu$ long ; branchial organ with 3 pairs of gills ; spermathecae present .. **carteri*

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*Species not known from the Indian sub-continent

## 20. **Aulophorus furcatus** (O.F. Müller, 1773)

Fig. 20 A-G

*Dero furcata* Oken. Brode, 1898, p. 143.

*Aulophorus furcatus* (Oken). Stephenson, 1915b, p. 784 ; 1925b, p. 46. Lastočkin, 1918, p. 62 ; 1927, p. 66. Cordero, 1931a, p. 350 ; 1931b, p. 334. Michaelsen, 1933, p. 338. Weisenberg-Lund, 1937, p. 339, fig. 403. Chen, 1944, p. 7. Du-Bois Raymond Marcas, 1947, pp. 6-7. Sperber, 1948, pp. 191-194, fig. 20B-D ; 1950, pp. 72-73, fig. 25; 1958, p. 49. Causey, 1953a, p. 55.

*Material examined*: Numerous worms collected from the Bugga stream, Cuddapah in October 1953, May and December 1955 ; from the Balaji tank, Kakinada in November 1956 ; from the Brucepettah tank, Bellary, Langford Town tank and Ulsoor tank, Bangalore in May 1958.

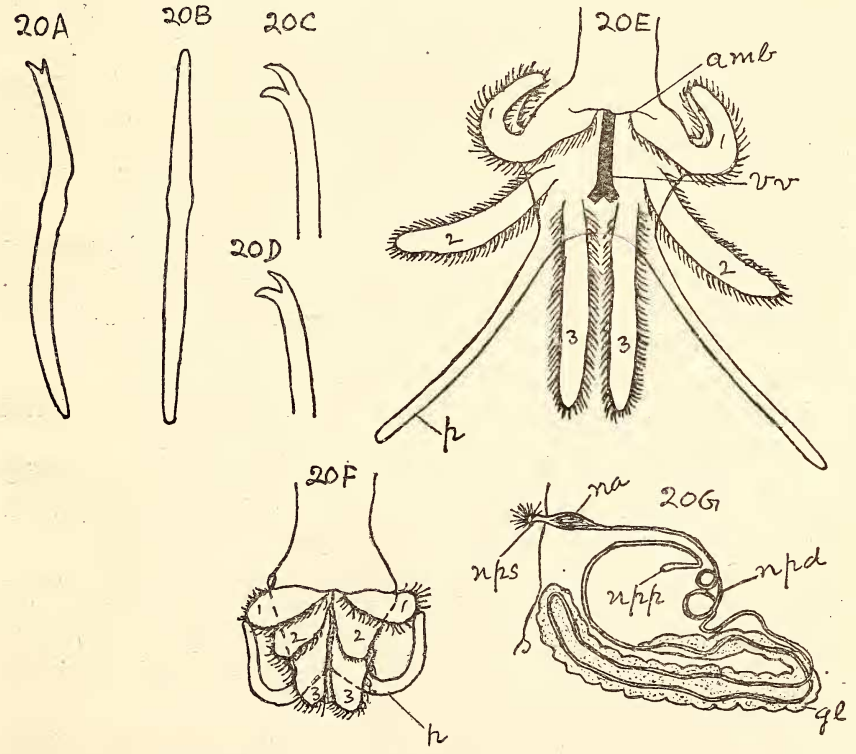


Fig. 20. *Aulophorus furcatus* (Müller). A. Needle seta × 900 ; B. Needle seta (front view) × 900 ; C. Distal end of ventral seta of II × 900 ; D. Distal end of ventral seta of VII × 900; E. Branchial organ relaxed ; F. Branchial organ preserved ; G. Nephridium.

*amb :* anterior margin of branchial fossa ; *gl* : gland ; *na* : nephridial ampulla ; *npd :* nephridial duct ; *npp :* nephridiopore ; *nps :* nephrostome ; *p :* palp ; *s :* septum; *vv* : ventral vessel ; 1, 2, 3 : I, II, and III pair of gills.

Worms small, light brown. Prostomium bluntly conical with stiff sensory hairs.

Dorsal setae start in V, 1 hair and 1 needle per bundle. Hairs 130-145 $\mu$ long, smooth, slightly curved. Needles (Fig. 20 A, B) sickle-shaped bifid, 49-55 $\mu$ long with distal nodulus (D : P : : 6 : 9), distal tooth thinner, shorter, and straighter than proximal. Ventral setae (Fig. 20 C, D) 4 per bundle anteriorly, 2–3 per bundle posteriorly ; in II-IV longer than in others, 63-70 $\mu$ long, with median nodulus (D : P : : 10 : 10 or 10 : 9), prongs equally thick, distal 1.5 times longer than proximal ; in others 49-60 $\mu$ long with distal nodulus (D : P : : 7 : 9), distal prong shorter and thinner than proximal. Length and thickness of crotchets, and length of distal prong, position of nodulus vary from seta to seta in bundles.

Branchial organ (Fig. 20 E, F) funnel-shaped, with 2 thin palps provided with sensory hairs, 0.4 mm. long and 70 $\mu$ wide at base, gradually tapering ; they diverge in distension, and curl their tips upwards with an obtuse angle between in contraction. Gills 3 pairs, foliate, I pair arise from supra-anal diverticulum, II pair from inside lateral margins, and III pair from the floor of fossa ; in distension I pair stretches laterally and curls upwards, II pair extends laterally, III pair stretches posteriorly ; in contraction they are withdrawn into fossa, when I pair is invisible.

Pharynx in II-V, wide. Oesophagus in VI-VII, thin and continues into intestine in VIII. Stomach absent. Chloragogues brownish. Septa well developed, each with colourless, transparent swellings ; septal glands in IV and V.

Brain incised anteriorly and posteriorly.

Blood yellow. Contractile vessels 5 pairs in VI-X, connect dorsal and ventral vessels. Simple non-contractile loops in II-V.

First pair of nephridia (Fig. 20 G) in VII, pre-septal funnels with nephrostomes in VI ; post-septal is a highly coiled duct, early part in gland tissue, later part opening by nephridiopore ventro-laterally.

Worms have 1-5 fission zones as in Argentine worms (Cernosvitov, 1942). After formation of first budding zone about the middle of the worm, two zooids develop and further fission zones appear successively in either zooid alternately. In a chain of 5 zooids, I and III zooids are composed of more segments than others.

Clitellum in $\frac{1}{2}$ V-VII ($2\frac{1}{2}$ segments). Gonads absent in sexually mature worms. Sperm-sac with spermatozoa and ovi-sac with single ovum extend to VIII and XI respectively, former within latter. Sperm-funnels cup-shaped, open in sperm-sac ; vasa deferentia thin, enter atria antero-dorsally. Atrial ampulla ovoid, with short ejaculatory duct opening at the position of ventral bundles of VI. No penial setae. Spermathecae long, club-shaped with ampullae twice as wide as ectal

duct, extend to VII or VIII in sperm-sac ; open slightly lateral to ventral bundles of V.

1 (p.) = 2-4 mm.; d (p.) = 0.22 mm.; s = 30-41 ; n = 16-20.

Lengths of longest setae in $\mu$ and position of nodulus in the ratio D : P ::

| | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hair | — | — | — | 129.5 | 133 | 133 | 136.5 | 133 | 133 | 133 | 136.5 |
| Needle | — | — | — | 52.5 | 49 | 49 | 49 | 49 | 49 | 49 | 49 |
| | | | | 6:9 | 5:9 | 5:9 | 5:9 | 5:9 | 5:9 | 5:9 | 5:9 |
| V. seta | 70 | 66.5 | 63 | 56 | 59.5 | 59.5 | 56 | 56 | 57.7 | 56 | 52.5 |
| | 10:10 | 10:9 | 9:9 | 8:8 | 8:9 | 8:9 | 7:9 | 7:9 | 7:9.5 | 7:9 | 6:9 |

*Distribution in Indian sub-continent :* Lahore (Pakistan) ; Bombay and Khed (W. India) ; Madras and Trivandrum (S. India). Now recorded from Cuddapah, Kakinada, Bellary, and Bangalore (S. India.)

*Habits :* Constructs tubes with mucus and foreign matter and lives in them. Buries anterior part of the body in mud, keeps the hind end protruded in water with gills distended, withdraws it into mud when disturbed. Swims with brisk horizontal transverse movements.

*Remarks :* The worms described here have no stomach, and have five pairs of contractile lateral vessels in VI-X, and a ventro-lateral dorsal blood vessel. In the absence of a stomach and in the presence of five pairs of contractile vessels, they resemble those of Stephenson (1923) and differ from the Swedish worms with a stomach and 2 pairs of contractile vessels. The dorsal vessel is ventro-lateral as in the Swedish worms, and Stephenson's statement that it is dorsal must be incorrect, as it is never found to be so in any species of *Aulophorus*. Setae length of the present worms agrees with those found in literature. The gills are foliate as in the Chinese worms (Chen, 1940). The spermathecae are club-shaped as in the Brazilian worms (Marcus, 1943).

Sexual organs resemble those of the Bombay (India) worms (Stephenson, 1916) and the Brazilian worms of Marcus (1943), except in the shape of the spermathecae. Stephenson described the spermathecae as ovoid sacs, when actually they are long and club-shaped. He examined, as he states, preserved, 'not quite fully mature', worms, and so there is every possibility of the spermathecae still being in coiled condition giving an ovoid appearance. His statements—the clitellum, ' not distinguishable except in sections ', and ' the individuals which were examined by sections had already copulated (presence of spermatozoa in the spermathecae)'—are contradictory. The worms could not have copulated before the full development of the clitellum, and the spermathecae cannot contain spermatozoa without copulation. Hence it is obvious that the 'spermatozoa and granular matter ' in the 'ovoid sacs,'

were actually the cut ends of the coils of the long ectal duct and ampulla of the spermatheca. The differences in the shape of the atria and the position of entry of the vasa deferentia into the atria between the Bombay worms of Stephenson on the one hand and the Brazilian and the present worms on the other are, again, due to the immature condition of the sexual organs in the former.

*Aulophorus africanus* Michaelsen (1914), with very slight incision in the dorsal border of the branchial organ and flattened form of the gills, has no distinct taxonomic status, as the gills have been found to be flat (foliate) in *A. furcatus* from China by Chen (1940) and in the present worms; further the branchial organ varies considerably in the members of a species. Stephenson's (1931b) key for the species of *Aulophorus* is :

| | | | |
|---|---|---|---|
| '1. | Dorsal setae begin in segment IV | | *A. superterranus* |
| | Dorsal setae begin in segment V | 2 | |
| | Dorsal setae begin in segment VI | 6 | |
| 2. | Two or three pairs of gills | 3 | |
| | Four pairs of gills | 4 | |
| 3. | Palps diverge at an obtuse angle | | *A. furcatus* |
| | Palps close together, diverge but slightly | | *A. africanus*' |

It is clear from the above that he could not find more tangible characters for separating *A. africanus* from *A. furcatus*, and hence differentiated them on the very trivial character of the divergence of the palps. Hence *A. africanus* is a synonym of *A. furcatus*.

*Dero roseola* Nicholls (1921) from Australia agrees with *A. furcatus* in all characters except in the larger size of the zooids, rarer budding zones, and value of n = 11-25 for *furcatus* in literature and n = 28 for *roseola*. These minor differences do not call for a specific status for *roseola*. As suggested by Marcus (1943) and Sperber (1948) this is also a synonym.

### 21. **Aulophorus michaelseni** Stephenson, 1923

Fig. 21 A-E

*Aulophorus palustris* Michaelsen. Stephenson, 1916, p. 306.

*Aulophorus michaelseni* Stephenson, 1923, pp. 93-94, fig. 35 ; Aiyer, 1930, p. 43, fig. 18.

*Material examined :* Many worms collected from the Bugga stream, Cuddapah in April 1954, May and December 1955 ; from the Kandakam tank, Bellary in April 1954 ; and from the Ulsoor tank, Bangalore in May 1958.

Worms of medium size, and pale red. Eyes absent. Prostomium bluntly conical.

Dorsal setae from V, 1 hair and 1 needle per bundle. Hair 175-200 $\mu$ long, smooth, nearly straight, shorter than body-diameter. Needle sickle-shaped (Fig. 21A) 65-70 $\mu$ long, with distal nodulus (D : P : : 7 : 12),

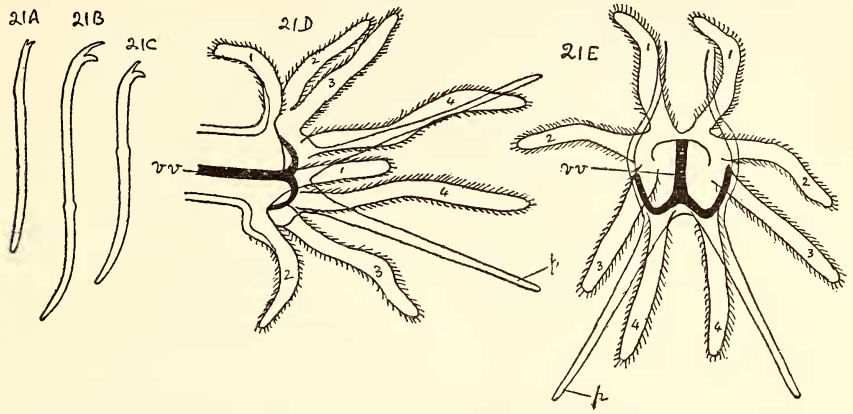


Fig. 21. *Aulophorus michaelseni* Stephenson : A. Needle seta × 450 ; B. Ventral seta of II × 400 ; C. Ventral seta of VIII × 450 ; D. Branchial organ relaxed under cover glass ; E. Branchial organ fully relaxed.

*p* : palp ; *vv* : ventral vessel ; 1, 2, 3, 4 : I, II, III, and IV pair of gills.

teeth small, equally thick, distal longer than proximal. Ventral setae (Fig. 21 B, C) 2-4 per bundle ; in II-IV, 77-98 $\mu$ long, with proximal nodulus (D : P : : 15 : 13), thinner, less curved than in others, prongs equally thick, distal 1.5-2 times longer than proximal ; in other segments 60-73.5 $\mu$ long, with distal nodulus (D : P : : 8 : 11), distal prong half as thick as proximal. Length and thickness of setae and nodular position vary from seta to seta in bundles. Distal prong is longer, equal to, and shorter than proximal in outer, middle, and inner setae respectively in a bundle.

Branchial organ (Fig. 21 D, E) funnel-shaped, anterior margin entire, ciliated, posterior margin bears 2 non-contractile elongated, thin, diverging palps. Gills 4 pairs, digitiform ; I pair dorsal, II pair lateral, III and IV pairs ventral. From I-IV pair length increases. In full distension gills curl in all directions like tentacles.

Pharynx in II-V, wide and whitish. Oesophagus in VI-VIII, thin, wavy, continues into intestine without stomach intervening. Septa well developed ; septal glands on septa 4/5 and 5/6. Chloragocytes brownish. Coelomocytes spherical, colourless with 15 $\mu$ diameter.

Blood deep orange-red. Simple contractile vessels 4 pairs in VII-X connecting dorsal and ventral vessels.

First nephridium in VII, its pre-septal ciliated nephrostome opening into VI : post-septal nephridial duct opening by nephridiopore ventro-laterally in VII.

Budding zone 1, rarely 2; when 2, second fission zone always appears about the middle of posterior zooid.

1 (p.) = 4-5 mm.; d (p.) = 0.3 mm.; s = 40-45 + undifferentiated zone and branchial organ; n = 23—27.

Lengths of longest setae in $\mu$ and position of nodulus in the ratio D : P : :

| | II | III | IV | V | VI | VII | VIII | IX | X | XI |
|---|---|---|---|---|---|---|---|---|---|---|
| Hair | — | — | — | 182 | 182 | 175 | 175 | 175 | 175 | 175 |
| Needle | — | — | — | 70 | 66.5 | 66.5 | 66.5 | 66.5 | 66.5 | 64.8 |
| | | | | 8:12 | 7:12 | 7:12 | 7:12 | 7:12 | 7:12 | 7:11.5 |
| V. seta | 98 | 98 | 96.2 | 85.7 | 73.5 | 70 | 70 | 70 | 66.5 | 70 |
| | 15:13 | 15:13 | 15:12.5 | 11.5:13 | 9:12 | 9:11 | 9:11 | 9:11 | 8:11 | 8:12 |

*Distribution in Indian sub-continent :* Kandy (Ceylon), Trivandrum (Travancore, S. India). Now recorded from Cuddapah, Bangalore, and Bellary (S. India).

*Remarks :* Stephenson (1923) separated the Indian specimens of *Aulophorus palustris* Michaelsen under the name *A. michaelseni* from those described by Michaelsen (1905a) on account of the needles of the former having been referred to 'Hakenborsten,' which term Stephenson considers applicable only to setae resembling the form of ventral setae. Stephenson is right as needle with proximal tooth thicker than the distal is referred to as 'Hakenborsten' by Michaelsen in *A. palustris* (1905a), and *A. borelli* Michaelsen (1900) differs considerably from the needles with equally thick teeth in *A. michaelseni* Sperber (1948). Sperber (1948) probably unable to distinguish *A. michaelseni* as a distinct species from the available descriptions included it with *A. furcatus* giving a comprehensive diagnosis for the latter. Characters of *A. michaelseni* warrant a specific status, hence it is here reassigned as a separate species after Stephenson (1923) with a diagnosis.

*Habits :* The worms swim with a transverse horizontal movement. When disturbed they coil into loose spirals, and uncoil and move away after a short time. Live along with *Limnodrilus hoffmeisteri.*

*Diagnosis of* Aulophorus michaelseni *Stephenson* : No eyes. Dorsal setae begin in V, 1 hair and 1 needle per bundle; hairs simple, nearly straight; needles with distal nodulus, bifid, teeth small, equally thick, distal tooth longer than proximal. Ventral setae 2-4 per bundle; in II-IV thinner, straighter than others, with proximal nodulus, prongs equally thick, distal 1.5-2 times as long as proximal; in others nodulus distal, distal prong half as thick and longer, equal to, or shorter than proximal. Branchial fossa with 4 pairs of digitiform gills, 1 dorsal, 1 lateral, and 2 ventral. Stomach absent. Septal glands on 4/5 and 5/6. Coelomocytes occur. Dorsal vessel ventrally to left; hearts 4 pairs in VII-X. First nephridium in VII. Budding zone buds 5 head segments.

## 22. **Aulophorus hymanae**[1] sp. nov.

Fig. 22 A-F

*Material examined :* Many worms collected from the Bugga stream, Cuddapah in September 1953, May 1955 ; from Miller's tank, Langford Town tank, and Ulsoor tank, Bangalore in May 1958.

Worms large and sturdy. Prostomium bluntly conical, longer than broad, with fine sensory hairs.

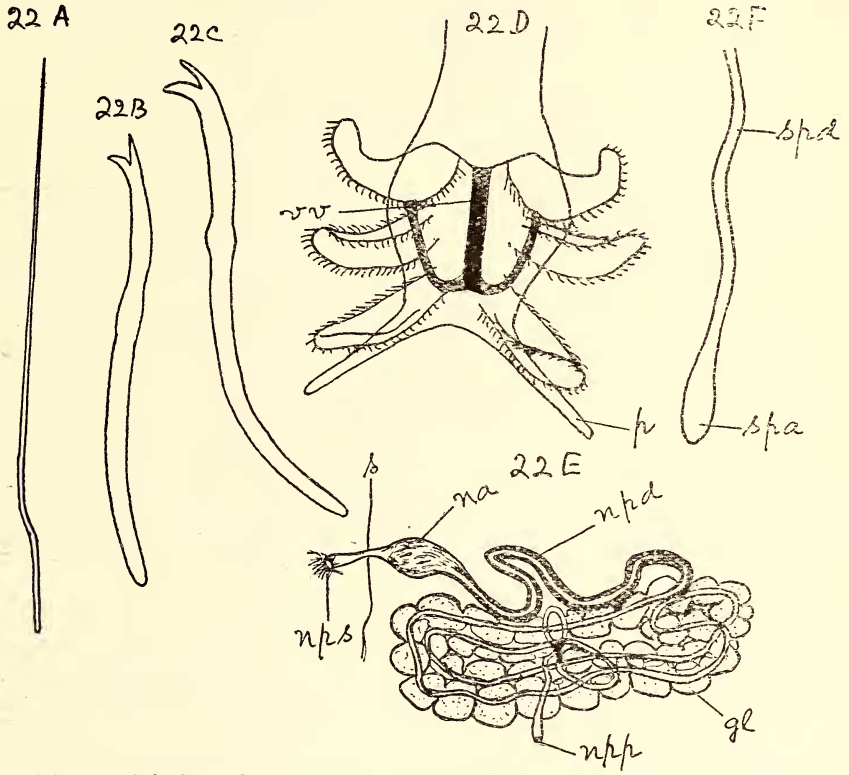


Fig. 22. *Aulophorus hymanae* sp. nov. : A. Hair seta × 275 ; B. Needle seta × 700 ; C. Ventral seta of II × 650 ; D. Branchial organ fully relaxed ; E. Nephridium ; F. Spermatheca.

*gl* : gland ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridial pore ; *nps* : nephrostome ; *p* : palp ; *s* : septum ; *spa* : spermathecal ampulla ; *spd* : spermathecal duct ; *vv* : ventral vessel.

Dorsal setae start in V, 1 hair and 1 needle per bundle. Hair (Fig. 22 A) smooth, bayonet-shaped, 224-273$\mu$ long. Needle (Fig. 22 B) sickle-shaped bifid with distal nodulus (D : P : : 7 : 14), shaft above nodulus curved with longitudinal ridge on outer margin, 73.5-80.5 $\mu$ long, distal tooth straighter, thinner, and slightly longer than curved proximal. Ventral setae (Fig. 22 C) 4-5 per bundle decreasing to 2-3 posteriorly, in

[1] Named after Dr. Libbie Henriette Hyman of the American Museum of Natural History, New York.

II-IV, 91-98 $\mu$ long, thinner, straighter than in others, nodulus median (D: P : : 14:14 or 13:14), distal prong longer (less than twice as long) and thinner than proximal ; in others, 73.5-87.5 $\mu$ long, distal prong thinner than and about equal in length to proximal ; position of nodulus, lengths of setae and outer prong vary from seta to seta in bundles.

| Length of ventral seta | Position of nodulus D : P : : | Relative length of distal prong to proximal |
|---|---|---|
| 84.0 $\mu$ | 11 : 13 | longer |
| 80.5 $\mu$ | 10 : 13 | slightly longer |
| 80.5 $\mu$ | 10 : 13 | equal |
| 78.5 $\mu$ | 9 : 13.5 | shorter |

Branchial organ (Fig. 22 D) funnel-shaped with 1 pair of long non-contractile, avascular palps and 3 pairs of digitate gills ; I pair arises from supra-anal diverticulum, II and III pairs spring from floor of fossa ; longest gills shorter than palps.

Pharynx in II-V, wide, yellowish, with dorsal diverticulum, eversible through mouth during feeding. Oesophagus thin, starts in VI, insensibly continues into intestine. Stomach absent. Chloragogues greenish grey. No coelomocytes. Septa well developed, each with 2 lateral colourless glassy swellings.

Brain incised anteriorly and posteriorly.

Blood red. Dorsal vessel contractile, mid-dorsal in head segments and ventrally attached to left of the gut from VI on, divides into 3 branches, which unite in II with non-contractile mid-ventral ventral vessel. Non-contractile simple loops in II-V ; contractile vessels 6 pairs in VI-XI.

First pair of nehpridia (Fig. 22 E) in VII, pre-septal funnel with nephrostome in VI, a slender neck connects it to post-septal, consisting of a fusiform ampulla followed by a duct, whose proximal part is thick-walled, middle part glandular, and ectal part thin-walled, with a vesicle before opening ventro-laterally.

Fission zones 1-2 common. In a 3-zooid chain, I fission zone is behind XXIV ; after some segments are budded for anterior zooid, II zone is developed at the same place as the I (i.e. between XXIV and first new segment). Composition of 3 zooids in one chain is : anterior zooid has 24 segments of parent body ; middle zooid has all newly budded segments ; posterior zooid has posterior segments of parent body and a few newly budded segments.

Clitellum from $\frac{1}{2}$V-VII ($2\frac{1}{2}$ segments), weaker between male pores. In fully mature sexual worm gonads absent, sexual elements present. Sperm-sac and ovi-sac extend to X and XI respectively when full, former within latter. Sperm-funnels thick-walled cups on anterior face of septum 5/6, with vasa deferentia entering atria in VI. Atrial ampullae ovoid, their ejaculatory ducts open at the position of ventral bundles of

Lengths of longest setae in $\mu$ and position of nodulus in the ratio D : P : :

| | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII | XIV | XV | XVI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hair | — | — | — | 224 | 238 | 245 | 245 | 234.5 | 248.5 | 248.5 | 252 | 259 | 245 | 245 | 248.5 |
| Needle | — | — | — | 77 | 78.7 | 77 | 80.5 | 73.5 | 73.5 | 73.5 | 73.5 | 73.5 | 73.5 | 73.5 | 78.7 |
| | | | | 8:14 | 8:14.5 | 8:14 | 8:15 | 7:14 | 7:14 | 7:14 | 7:14 | 7:14 | 7:14 | 7:14 | 8.5:14 |
| Crotchet | 98 | 91 | 94.5 | 84 | 87.5 | 85.7 | 84 | 80.5 | 80.5 | 84 | 84 | 84 | 80.5 | 77 | 80.5 |
| | 14:14 | 13:13 | 13:14 | 11:13 | 11:14 | 10:14.5 | 10:14 | 9:14 | 10:13 | 10:14 | 9:15 | 9:15 | 9:14 | 9:13 | 9:14 |

VI on papillae, round which clitellum is absent. Female funnels not observed, female pores indistinct in VII ventrally. Spermathecae (Fig. 22 F) a pair in V, club-shaped, extend to VIII in sperm-sac ; open lateral to ventral bundles of V. No penial setae.

1(p.) = 8-10 mm.; d (p.) = 0.4 mm.; s = 50-80; n = 22-39.

*Habits :* Worms live in mucus tubes with anterior $\frac{1}{2}$-$\frac{2}{3}$ buried in mud, and the rest protruding vertically up in water with gills fully distended. When disturbed, they withdraw their hind ends and disappear into mud. Hind part of body is not waved about. Swim with horizontal transverse undulations.

*Commensals :* Vorticellids are found attached to setae at either end of body.

*Taxonomic discussion:* Of the 15 species (13 of Sperber, 1948, *Aulophorus michaelseni*, and *A. indicus* sp. nov. created here) this resembles only 5 species in its dorsal setae starting in V. Amongst these it further resembles *A. furcatus* (Müller), *A. borelli* Michaelsen, and *A. michaelseni* Stephenson in having bifid needles (*A. pectinatus* Stephenson and *A. indicus* sp. nov. have pectinate and trifid needles respectively). It resembles closely *A. furcatus* in having 3 pairs of gills and differs from *A. michaelseni* and *A. borelli* both with 4 pairs of gills. With the distal tooth of the needle longer than proximal and the hairs peculiarly bayonet-shaped, it differs from *A. furcatus* with distal needle tooth shorter than proximal and hairs simple, nearly straight. Minor differences are more hearts (6 pairs as against 5 pairs); greater body size (8-10 mm. as against 2-4 mm.) and greater size of setae (hairs 224-252 $\mu$ long as against 85-200 $\mu$, needles 73.5-80 $\mu$ long as against 45-62.5 $\mu$; ventral setae 77-98 $\mu$ long as against 52-72 $\mu$).

*Diagnosis of* Aulophorus hymanae *sp. nov.* : No eyes. Dorsal setae start in V, 1 bayonet-shaped hair and 1 bifid needle, with distal tooth straighter, thinner, and slightly longer than curved proximal, per bundle. Ventral setae 4-5 per bundle anteriorly, 2-3 posteriorly; in II-IV longer, thinner, straighter than in others, nodulus median, distal prong longer and thinner than proximal ; in others distal prong thinner, about equal in length to proximal, position of nodulus, lengths of setae and distal prong vary from seta to seta in bundles. Branchial fossa with 1 pair of long palps and 3 pairs of foliate gills, one dorsal and 2 ventral. Stomach absent. No coelomocytes. Septa with colourless swellings.

Blood red. Dorsal vessel ventrally to left, simple non-contractile loops in II-V, contractile lateral vessels 6 pairs in VI-XI. Clitellum in $\frac{1}{2}$V-VII ; seminal funnels cup-shaped ; atria ovoid ; no penial seta ; spermathecae club-shaped.

Budding present, 5 head segments are budded.

*Type :* The type specimen is being deposited with the Zoological Survey of India, Calcutta.

## 23. **Aulophorus indicus** sp. nov.

Fig. 23 A-D

*Material examined :* A few worms collected from the Bugga stream, Cuddapah in April 1954.

Worms of medium size and crimson colour. Prostomium bluntly triangular without sensory hairs. Eyes absent.

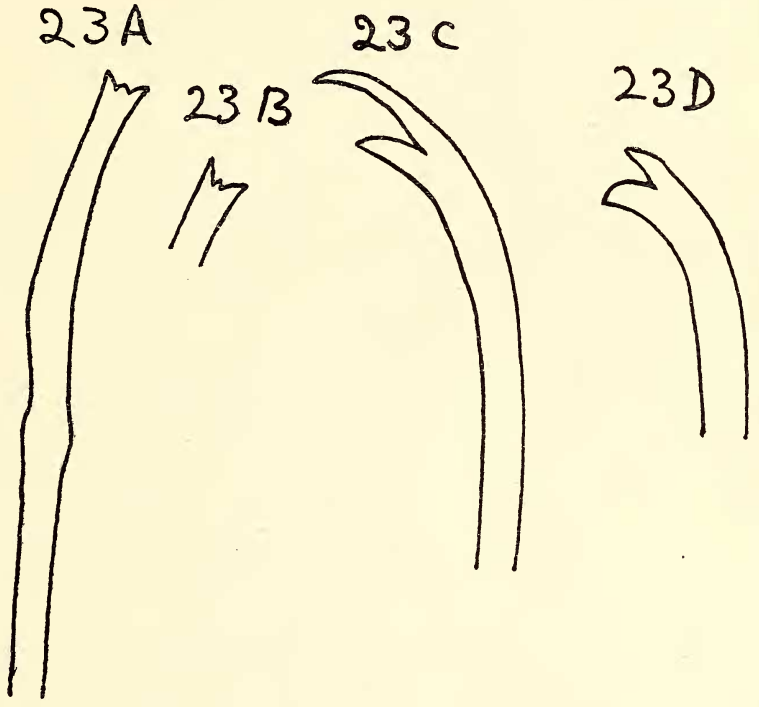


Fig. 23. *Aulophorus indicus* sp. nov. : A. Distal end of needle seta (old) × 2000 ; B. Distal end of needle seta (new) × 2000 ; C. Distal end of ventral seta of $II_d^i$ × 2500 ; D. Distal end of ventral seta of VIII × 2500.

Dorsal bundles begin in V, each bundle has 1 hair, smooth, bayonet-shaped, up to 200 $\mu$ long and 1 needle (Fig. 23 A, B), bifid, 1.5 $\mu$ thick, with one short intermediate tooth, thick in old segments, fine in newly budded segments, main teeth equally long, proximal thicker than distal, nodulus distal, 21 $\mu$ from distal end. Ventral setae (Fig. 23 C, D) in II-V, 3 per bundle, 2 $\mu$ thick, with proximal nodulus, equally thick prongs, distal more than twice as long as proximal ; in others, 3-4 per bundle anteriorly, 1-2 posteriorly, with distal nodulus, 2.8 $\mu$ thick, prongs equally long in anterior segments, distal prong decreasing in length posteriorly, proximal twice as thick as distal.

Branchial organ wide, cup-shaped with postero-dorsal opening, 1 pair of short palps and 1 pair dorsal and 2 pairs ventral gills; palps thin and fold over fossa in contraction.

Pharynx in II-V, wide. Oesophagus in VI-VII, thin. Stomach in VIII-IX. Intestine narrow in X and XI, wide behind; ascending ciliary action and anti-peristalsis occur. Chloragogues from VI on. Coelomocytes opaque, spherical, and morula-like. Septa well developed; septal glands not observed.

Blood crimson red. Dorsal blood vessel ventrally to left from hind end to VI, mid-dorsal cephalad. Simple contractile loops 4 pairs in VI-IX, first 2 pairs thinner than others. Ventral vessel median and wavy.

First nephridium in X, its preseptal funnel in IX.

Brain incised medianly at either end.

No budding zones observed in 8 worms. Fragmentation seems to occur. In one worm segments behind XXX are smaller and younger, evidently regenerated after fragmentation. From newly developed first dorsal bundle in V, it is obvious that 5 segments are regenerated anteriorly for posterior fragment.

Sexual worms not encountered.

l (p.) = 3-6 mm.; d (p.) = 0.2 mm.; s = 47-60 + undifferentiated region ending in branchial fossa; n = 30 (in one).

*Taxonomic discussion :* This species closely resembles *Aulophorus pectinatus* Stephenson. In having a small, short, intermediate tooth between main needle teeth, 3 pairs of gills, and a distinct stomach, it differs from the latter with 2-4 long intermediate teeth between main needle teeth, 4 pairs of gills and no stomach. Hence it is given the status of a new species.

*Diagnosis of* Aulophorus indicus *sp. nov. :* No eyes. Dorsal setae start in V, 1 hair and 1 needle per bundle. Hair bayonet-shaped; needle bifid with short intermediate tooth, nodulus distal. Ventral setae of II-V straighter, longer, and thinner than rest, 3 per bundle with proximal nodulus, equally thick prongs, distal more than twice as long as proximal; in others 1-4 per bundle, teeth equally long in anterior segments, distal tooth decreasing in length posteriorly; proximal twice as thick as distal. Stomach, coelomocytes, septal glands absent. Gills 3 pairs, 1 dorsal, 2 ventral. Architomy (fragmentation) occurs, 5 head segments are regenerated.

*Type:* The type specimen is being deposited with the Zoological Survey of India, Calcutta.

## 24. **Aulophorus tonkinensis** (Vejdovsky, 1894)

Fig. 24 A-H

*Aulophorus tonkinensis* (Vejdovsky). Stephenson, 1913b, pp. 738, 744, 757. Sperber, 1948, pp. 196-197 ; 1958, pp. 49-50, figs. 8-9.

*Material examined :* Numerous worms collected from the Bugga stream, Cuddapah in March 1954, May 1955, January 1956 ; from the Pullalamadugu stream near Cuddapah on 10-6-1954 ; from the Balaji tank, Kakinada in November 1956 ; from the Langford Town tank, Bangalore in May 1958.

Worms small, pale white, and transparent. Head end swells in preservation. Prostomium bluntly triangular with stiff sensory hairs. Eyes absent.

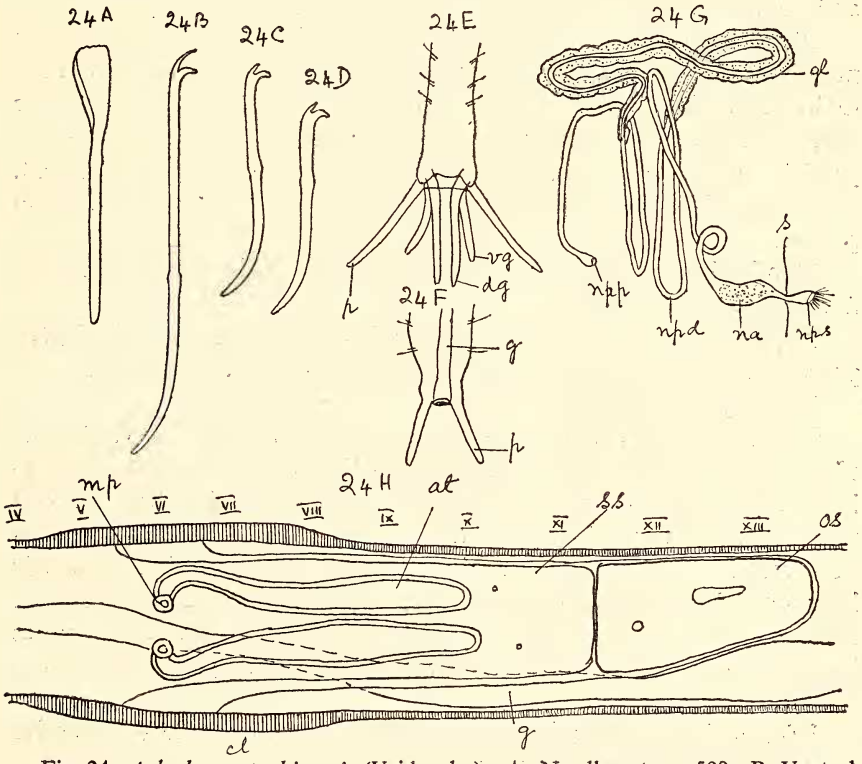


Fig. 24. *Aulophorus tonkinensis* (Vejdovsky) : A. Needle seta × 500; B. Ventral seta of II × 500 ; C. and D. Ventral seta of the posterior segment × 500 ; E. Branchial organ (relaxed) ; F. Branchial organ (contracted) ; G. Nephridium ; H. Anterior part of sexual worm.

*at* : atrium ; *cl* : clitellum ; *dg* : dorsal gill ; *g* : gut ; *gl* : gland ; *mp* : male pore ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridial pore ; *nps* : nephrostome; *os* : ovi-sac ; *p* : palp ; *s* : septum ; *ss* : sperm-sac ; *vg* : ventral gill.

Dorsal setae begin in VI, 1 hair and 1 needle (occasionally 2 of each) per bundle. Hairs bayonet-shaped, smooth, 105-122.5 $\mu$ long, shorter than body-diameter. Needles (Fig. 24A) palmate, nearly

straight, 63-70 $\mu$ long, nodulus distal (D : P : : 7 : 11), with 2 very long teeth with webbing, without ribs, resembling oars. Ventral setae (Fig. 24 B, C, D) in II-V straighter, thinner than others, 4-5 per bundle, 80-98 $\mu$ long, with proximal nodulus (D : P : : 17 : 10 or 16 : 10), distal prong longer and thinner than proximal ; from VI on 3-4 per bundle, 49-56 $\mu$ long, with distal nodulus (D : P : : 6 : 9), distal prong shorter and thinner than proximal.

Branchial organ (Fig. 24 E, F) cup-shaped, fossa opening posteriorly with 2 palps, armed with stiff sensory hairs, palps parallel in contraction and diverge in relaxation. Gills 2 pairs, digitiform, shorter than palps ; 1 pair dorsal, longer, stretching backwards, gills parallel to each other ; 1 pair ventral, shorter, diverge slightly and curl upwards in relaxation and are completely withdrawn into fossa in contraction.

Pharynx in II-V, ciliated and thick-walled, eversible through the mouth in the form of disc-like sucker, used for feeding and locomotion. Oesophagus in VI-VIII, thin. Stomach in IX, marked. Intestine thin in X-XI, thick from XII on ; chloragogues cover gut from VI, greyish. Coelomocytes spherical and granular. Septal glands absent.

Brain incised deeply in front and behind with a faint dorso-median groove.

Blood yellow. Simple contractile vessels 2 pairs in VII-VIII, connect dorsal and ventral vessels.

Nephridia commence with VIII or IX, one per segment (Fig. 24 G), pre-septal in anterior, post-septal in posterior, of the two segments.

Budding zone single.

Clitellum from V-$\frac{1}{2}$VIII ($3\frac{1}{2}$ segments), weak ventrally in V. Gonads absent in sexually mature worms (Fig. 24 H). Sperm-sac with developing sperms and ovi-sac with single large ovum extend to XII and XIII when full, former within latter. Sperm-funnels and ovi-ducts not observed in living worms. Atrial ampullae club-shaped, enormously long, extend to VIII within sperm-sac, when full. Penial setae absent. Male pores in the situation of ventral bundles of VI, female pores in the groove between VI and VII vebtro-laterally. Spermathecae absent.

1 (p.) = 1.2-2.0 mm.; d (p.) = 0.16-0.18 mm.; s = 20-25 + formative zone ending in branchial organ ; n = 15.

Lengths of longest setae in $\mu$ and position of nodulus in the ratio D : P : :

| | II | III | IV | V | VI | VII | VIII | IX | X | XI |
|---|---|---|---|---|---|---|---|---|---|---|
| Hair | — | — | — | — | 122.5 | 122.5 | 122.5 | 119 | 105 | 112 |
| Needle | — | — | — | — | 63<br>7:11 | 63<br>7:11 | 63<br>7:11 | 66.5<br>7:12 | 66.5<br>8:11 | 66.5<br>8:11 |
| V. seta | 98<br>18:10 | 96.2<br>16:11.5 | 94.5<br>17:10 | 91<br>16:10 | 52.5<br>7:8 | 54.2<br>7:8.5 | 54.2<br>9:5 | 52.5<br>6:9 | 56<br>7:9 | 56<br>7:9 |

*Distribution in Indian sub-continent :* Calcutta, Lucknow, Bhim Tal (N. India); Travancore (S. India). Now recorded from Cuddapah, Bangalore, and Kakinada (S. India).

*Habits :* Worms live in thin transparent chitinous tubes covered with fragments of leaves and wood, dark granules, sand, etc., tubes hang down with one end attached. They move freely within the tubes and can turn round interchanging positions of head and branchial organ. While resting, head end and branchial organ are protruded out of tubes. Extending the anterior part of its body some distance in front of the tube, it everts pharyngeal sucker and stretches anterior ventral setae, fixes them to substratum and contracts the body, dragging the tube along. Swim with brisk horizontal undulations when freed from tube.

*Remarks :* Present worms have a marked stomach. Stephenson (1923) indicates presence of stomach in IX. Chen (1940, p. 62) in his diagnosis points out : ' no special stomachic dilatation. Oesophagus swelling in VIII '. His ' Oesophageal swelling in VIII ', obviously is the stomach.

Though Michaelsen (1914) suggested that *Aulophorus oxycephalus* Schmarda, 1861 is identical with *A. tonkinensis* (Vejdovsky, 1894), and Chen (1940) united the two into one under the former name on nomenclatural priority ; it is difficult to determine the identity of the former either as a distinct species or a synonym of the latter. All the characters that are available of the former from the original description are : (1) presence of two short appendages (palps) at the posterior end, (2) circular mouth with a pharyngeal sucker, (3) presence of a tube round its body, (4) dragging type of locomotion similar to that seen in *A. tonkinensis* and *A. vagus*, (5) absence of a stomach, (6) length : 5 mm., diameter : 0.25 mm., (7) dorsal bundles with 3 hair-like setae and ventral bundles with 3 forked setae. In characters (1) to (4) it resembles *A. tonkinensis*. It differs in the absence of a stomach. Length of 5 mm. is greater than that known for *A. tonkinensis* (3.5 mm.) and the 3 setae in the ventral bundles are the minimum found in the hind segments of *A. tonkinensis*. The absence of information regarding the shape etc. of the needles and the setal lengths does not permit of a definite identity. Further investigation on this form is necessary before any decision is reached.

*Dero stuhlmanni* Stieren (1892) from Trinidad, West Indies, with dorsal setae starting in VI with 1 hair and 1 simple pointed needle; ventral bundles with 5 setae ; branchial organ, with 2 pairs of gills and 1 pair of palps ; length : 2 mm., agrees with *A. tonkinensis* except in the simple-pointed condition of the needles. As pointed out by Michaelsen (1914), the palmate needles often show themselves on their narrow side, when

they appear simple-pointed. It is highly probable that Stieren observed the needles on their narrow side and described them as simple-pointed, which is erroneous. This form is most probably a synonym of *A. tonkinensis*.

## 8. Genus **Allonais** Sperber, 1948

In the diagnosis of the genus, Sperber (1948) includes absence of stomachal dilatation as one of the characters. In the three species I examined the stomach is present. It is barrel-shaped from XIV-XX or XXI in *A. inaequalis*, fusiform from XI-XII in *A. rayalaseemensis*, and weak from IX-X in *A. gwaliorensis*. Its presence evidently was not clear in the single preserved worm of *A. gwaliorensis* examined by Stephenson (1920) and was overlooked by Chen (1940).

*A. gwaliorensis* has penial setae, as is the case with all other species of the genus. Chen (1940) seems to have overlooked them.

*Generic characters :* Eyes absent. Prostomium bluntly triangular. Dorsal setae normally from VI, hairs and double-pointed or pectinate needles ; ventral setae of II-V only slightly different from those of other segments. Stomach present (or absent ?) ; intestinal anti-peristalsis and ascending ciliary vibration occur ; chloragocytes from VI on. Septal glands absent ; coelomocytes present. Dorsal vessel contractile, attached ventrally to the gut on the left side from the hind end to VI, mid-dorsal in 5 anterior segments ; ventral vessel non-contractile and mid-ventral ; usually a vascular plexus in II-V ; and simple vessels in following segments present. Budding zones absent ; fragmentation occurs ; 5 or 6 head segments budded. Sperm-sac and ovi-sac, posterior diverticula of septa 5/6 and 6/7, the former within the latter, extending backwards ; vasa deferentia enter atria above the atrial duct ; no prostate gland cells ; penial setae present.

*Generic type* : *Allonais inaequalis* (Stephenson)

### Key to all the known and valid Species of *ALLONAIS*

A-1 Needle setae bifid
- B-1 Needle teeth curved (distal end horse-shoe shaped) .. * *chelata*
- B-2 Needle teeth straight
  - C-1 Distal tooth of needles longer than proximal .. *gwaliorensis*
  - C-2 Proximal tooth of needles longer than distal
    - D-1 Needles with noduli ; dorsal setae beginning in VI ; regenerate anterior 5 segments

| | | |
|---|---|---|
| E-1 Needle teeth parallel | .. | *paraguayensis paraguayensis* |
| E-2 Needle teeth diverging | .. | *rayalaseemensis* sp. nov. |
| D-2 Needles without noduli; dorsal setae beginning in VII; regenerates anterior 6 segments | .. | * *paraguayensis aequitorialis* |
| A-2 Needle setae pectinate | | |
| F-1 Needles have proximal tooth longer and thicker than the distal | .. | *inaequalis* |
| F-2 Needles have equally long and thick teeth | .. | *pectinata* |

* Species not known from the Indian sub-continent.

## 25. **Allonais inaequalis** (Stephenson, 1911)

Fig. 25 A-C

*Allonais inaequalis* (Stephenson). Sperber, 1948, pp. 201-202, Fig. 21A-D.

*Material examined :* A few worms from the Bugga stream, Cuddapah in January 1956.

Largest of all naidid worms in the locality, light brown, with irregular reddish brown patches near dorsal bundles. Eyes absent. Prostomium longer than broad, without sensory hairs.

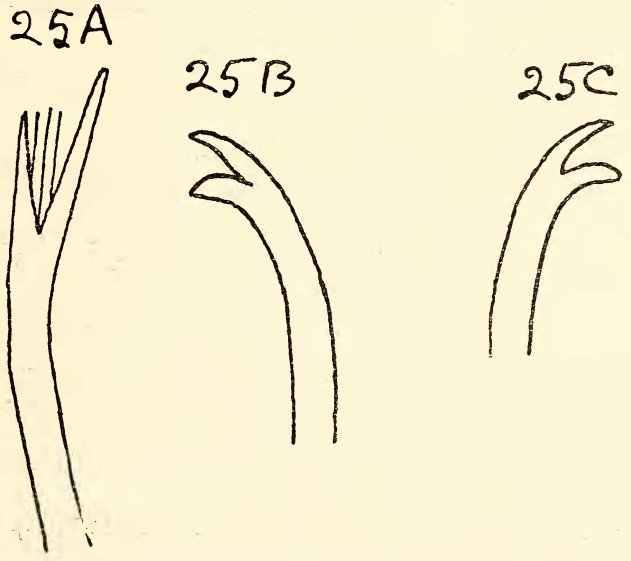


Fig. 25. *Allonais inaequalis* (Stephenson) : A. Distal end of needle seta, B. Distal end of ventral seta of II; C. Distal end of ventral seta of a middle segment.

Dorsal setae begin in VI, 1-2 hairs and 1-2 needles per bundle. Hairs smooth, slightly curved and about half the body-diameter. Needles (Fig. 25A) have 2 straight teeth with 1-3 fine, long, intermediate teeth, nodulus 3/8 - 2/5 from distal end, proximal tooth thicker and 1.5

times longer than distal. In one worm hairs 192.5-364 $\mu$ long, needles 98 $\mu$ in VI and 129.5-143 $\mu$ long in others ; ventral setae 101.5-105 $\mu$ long, in II-V and 115.5-127.7 $\mu$ long in others. Ventral setae (Fig. 25 B, C) have median nodulus in II-V, distal in others ; prongs unequal, distal thinner than proximal, length of distal prong slightly longer to equal in the setae of bundles.

Pharynx in II-V, wide, protrusible in the form of bulb through mouth for feeding. Oesophagus in VI-XIII, narrow. No pharyngeal and oesophageal glands. Stomach in XIV-XX or XXI. Intestine narrow in XXII and XXIII, wide behind ; chloragogues brown. Coelomocytes granular. Septa well developed, no septal glands. Anus postero-dorsal in a miniature fossa.

Brain incised in front and behind.

Blood red. Dorsal vessel mid-dorsal in anterior 5 segments, laterally to left in remaining segments. Contractile vessels 10 pairs in VII-XVI, connect dorsal and ventral vessels. Anterior segments with vascular plexus.

Nephridia begin in VIII, 1 per segment, pre-septal funnel with ciliated nephrostome, connected by slender duct to post-septal, consisting of fusiform brown ampulla and a long duct, its middle part passing through gland tissue, ectal duct ending in nephridiopore ventro-laterally.

No budding ; fragmentation occurs. Hind fragment regenerates 5 head segments and prostomium, anterior fragment an indefinite number of hind segments.

Clitellum from V-VIII (4 segments), absent between male pores. Gonads not seen in sexually mature worms. Sperm-sac with sperms and ovi-sac with single ovum extend to VIII and X respectively. Sperm funnels thick-walled cups opening into sperm-sac. Atrial ampulla spherical, with short, thick ejaculatory duct opening by transverse pore slightly lateral to penial setae in VI. Penial setae 2-3 per bundle with simple distal hook. Female pores large and transverse in intersegmental groove of VI and VII, in a line with ventral bundles. Dorsal bundles of VI-VIII are lost in sexual worms. Spermathecal ampullae ovoid (smaller than atrial ampulla) in V with their pores a little median to and in front of ventral bundles of V.

1 (p.) = up to 20 mm. ; d (p.) = 0.7 mm. ; s = up to 110 + undifferentiated zone ; n = 47 (in one).

*Distribution in Indian sub-continent:* Agra (N. India) ; Bheemanagar (Travancore, S. India). Now recorded from Cuddapah (S. India).

*Habits :* Live in aquatic plants and decaying vegetable matter, feeding on them. Swim by slow horizontal undulations.

*Remarks :* Setal measurements of the present worms are larger than those found in literature.

## 26. **Allonais rayalaseemensis** sp. nov.

Fig. 26 A-F

*Material examined :* Several worms collected from the Bugga stream, Cuddapah in November 1953, January 1954 ; from the Kandakam tank, Bellary in April 1954.

Worms large, yellowish brown, with orange-red patches in head segments at sexual maturity. Eyes absent. Prostomium bluntly triangular, longer than broad, with sensory hairs, enclosing coelomic fluid and corpuscles.

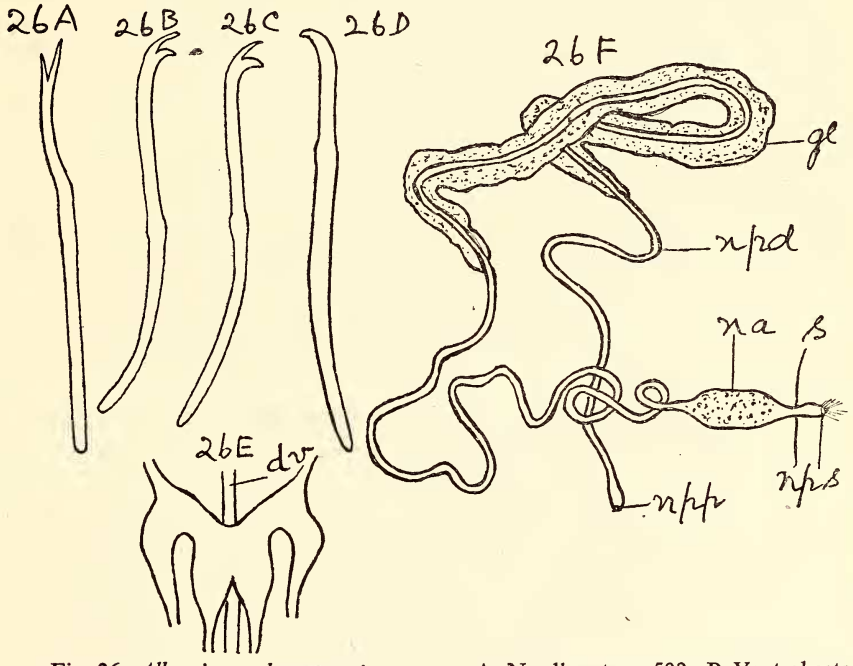


Fig. 26. *Allonais rayalaseemensis* sp. nov. : A. Needle seta × 500 ; B. Ventral seta of II × 500 ; C. Ventral setae of XIII × 500 ; D. Penial seta × 575 ; E. Brain ; F. Nephridium.

*dv :* dorsal vessel ; *gl :* gland ; *na :* nephridial ampulla ; *npd :* nephridial duct *npp :* nephridial pore ; *nps :* nephrostome ; *s :* septum.

Dorsal setae start in VI, 1-2 hairs and 1-2 needles per bundle. Hairs simple, smooth, straight 238-366 $\mu$ long. Needles sickle-shaped (Fig. 26 A) bifid, 80.5-105 $\mu$ long, nodulus distal (D : P : : 11 : 18), teeth diverging, proximal tooth slightly bent, twice as long and thick as distal. Ventral setae (Fig. 26 B, C) 4-7 per bundle, in II-V with median nodulus (D : P : : 13 : 12), in others distal nodulus (D : P : : 11 : 15) ; in II up to 91 $\mu$ long, gradually decreasing to 84 $\mu$ in V, abruptly increasing to 91 $\mu$ in succeeding segments. Distal prong thinner and longer than proximal.

Pharynx in II-V, wide and ciliated, partly eversible through mouth for feeding. Oesophagus in VI-X, thin and wavy. Stomach in XI-XII, fusiform. Pharyngeal and oesophageal glands absent. Intestine thin in XIII and wide in following segments, ascending ciliary vibration and anti-peristalsis occur. Anus dorsal, extends from side to side, anterior margin medianly incised, and resembling miniature fossa with inner surface ciliated. Chloragogues from VI, greenish brown. Coelomocytes granular, spherical, 14-17 $\mu$ in diameter. Septa well developed, no septal glands.

Brain (Fig. 26 E) incised deeply behind and less deeply in front.

Blood orange-red. Dorsal vessel attached to left wall of gut from hind end to VI, mid-dorsal anteriorly, divides into 2 in prostomium, branches unite with ventral vessel in II. Anterior 5 segments have a plexus of blood vessels formed of lateral vessels ; contractile vessels 6 pairs in VI-XI.

First nephridium (Fig. 26 F) in VII with its nephrostome in VI, connected by a neck passing through septum to post-septal, consisting of an anterior fusiform, granular ampulla and a long coiled nephridial duct, middle part passing through gland tissue and ectal part forming a vesicle before opening to exterior ventro-laterally.

Budding absent ; fragmentation occurs. Posterior fragment regenerates 5 head segments and prostomium ; anterior fragment regenerates several hind segments.

Clitellum opaque from $\frac{1}{2}$V-$\frac{1}{2}$VIII (3 segments). In worms with clitellum gonads absent, evidently absorbed after production of sexual cells. Male and female funnels not observed owing to opacity of clitellum. Atria with ovoid ampullae and short thick ejaculatory ducts open near ventral bundles of VI. Penial setae (Fig. 26 D) 4-5 per bundle 119 $\mu$ long and hooked distally. Sperm- and ovi-sac, back-pouchings of septa 5/6 and 6/7, extending to X and XIII respectively, the former within the latter. Spermathecal ampullae ovoid and open by pores in front of ventral bundles of V.

1 (living) = 18-20 mm.; 1 (preserved) = 11-13 mm. ; d (p.) = 0.4 mm.; s = 93-118 + undifferentiated zone; n = 48 and 54 in 2 worms.

Lengths of longest setae in $\mu$ and position of nodulus in the ratio D : P : :

| | II | III | IV | V | VI | VII | VIII | IX | X | XI |
|---|---|---|---|---|---|---|---|---|---|---|
| Hair | — | — | — | — | 280 | 245 | 294 | 322 | 301 | 366 |
| Needle | — | — | — | — | 91 | 101.5 | 105 | 101.5 | 101.5 | 101.5 |
| | | | | | 9:17 | 11:18 | 10:19 | 11:18 | 11:18 | 11:18 |
| Crotchet | 91 | 87.5 | 84 | 84 | 87.5 | 87.5 | 91 | 91 | 91 | 87.5 |
| | 14:12 | 13:12 | 12:12 | 12:12 | 11:14 | 11:14 | 12:14 | 12:14 | 11:15 | 11:14 |

*Habits:* Live among algae and decaying vegetable matter feeding on them. Worms left in a vessel of water (without any aquatic plants) entangle themselves with one another to form knotty masses ; on removal to a slide with some water, they move away in all directions. Swim by slow transverse movements.

*Taxonomic discussion :* Of the 5 species in this genus, it closely resembles *Allonais paraguayensis paraguayensis* (Michaelsen) in the possession of non-pectinate needles with proximal tooth thicker and longer than distal; and differs from it in having diverging needle teeth (teeth nearly parallel in *paraguayensis*), and smaller setae (larger in *paraguayensis*).

*Diagnosis of* Allonais rayalaseemensis *sp. nov.*: No eyes. Dorsal setae begin in VI. 1-2 hairs and 1-2 needles with straight diverging teeth, proximal twice as long and as thick as distal ; nodulus distal. Ventral setae 4-7 per bundle, all about equally long with distal prong slightly longer and thinner than proximal, in anterior segments nodulus median, in others distal. Vascular system forms a plexus in II-V ; 6 pairs of contractile lateral vessels in VI-XI. Stomach in XI-XII. Clitellum in $\frac{1}{2}$V-$\frac{1}{2}$VIII ; atria ovoid ; penial setae with simple distal hook, 4-5 per bundle. Fragmentation occurs.

*Type :* The type specimen is being deposited in Zoological Survey of India, Calcutta.

### 27. **Allonais gwaliorensis** (Stephenson, 1920)

Fig. 27 A-F

*Allonais gwaliorensis* (Stephenson). Sperber, 1948, pp. 205-206.
(?) *Allonais gwaliorensis* (Stephenson). Sperber, 1958, p. 50, figs. 10-12.

*Material examined :* Several worms collected from the Bugga stream, Cuddapah, all round the year from 1952-55 and 1957 ; from the Balaji tank, Kakinada in July and November 1956.

Worms of medium size, delicate, slender, and pale white. Prostomium bluntly triangular, slightly longer than broad without sensory hairs.

Dorsal bundles of setae begin in VI, 1-2 hairs and 1-2 needles per bundle. Hairs simple, smooth, 140-161 $\mu$ long. Needles sickle-shaped (Fig. 27 A), bifid with weak nodulus, a third from distal end, 59.5-66.5 $\mu$ long, distal tooth thinner, slightly longer, and straighter than proximal, with deep acute angle between the teeth. Ventral setae (Fig. 27 B, C) in II-V, 4-5 per bundle, 56-63 $\mu$ long, 2 $\mu$ thick, thinner, straighter than others, prongs equally thick, distal longer and more hooked than proximal ; in others, 4-6 per bundle, 52.5-56 $\mu$ long, 2.5 $\mu$ thick, distal prong thinner and slightly longer than proximal. Nodulus slightly proximal in

II-IV, median in V, and distal in others; position of nodulus is fairly constant in setae of bundles.

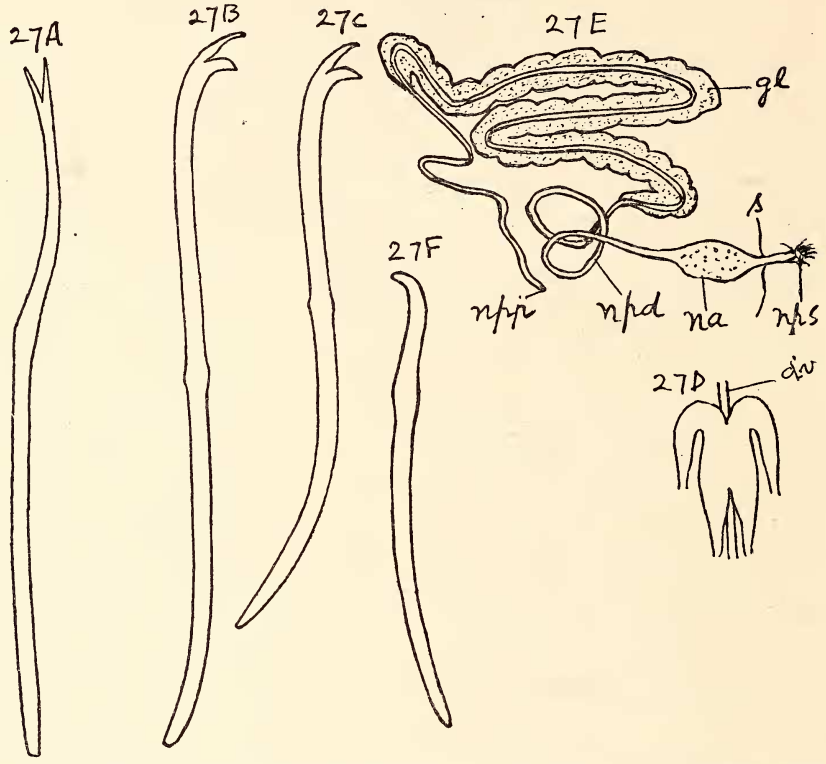


Fig. 27. *Allonais gwaliorensis* (Stephenson) : A. Needle seta × 1200 ; B. Ventral seta of II × 1200 ; C. Ventral seta of XIII × 1200 ; D. Brain ; E. Nephridium ; F. Penial setae × 800.

*dv* : dorsal vessel ; *gl* : gland ; *na* : nephridial ampulla ; *npd* : nephridial duct ; *npp* : nephridial pore ; *nps* : nephrostome ; *s* : septum.

Pharynx in II-V, ciliated, wide, and eversible through the mouth in the form of a bulb for feeding. Oesophagus in VI-VIII, narrow. No pharyngeal and oesophageal glands. Stomach in IX-X, weak. Intestine thin in XI and XII, wide in rest. Anus is postero-dorsal. Chloragogues greenish brown. Coelomocytes whitish, spherical 10-14 $\mu$ in diameter. Septa well developed, no septal glands.

Brain (Fig. 27 D) incised deeply posteriorly and less deeply anteriorly.

Blood yellowish. Contractile lateral vessels 3 pairs in VI-VIII ; non-contractile vessels 4 pairs in II-V.

Nephridia (Fig. 27 E) start in VII, one per segment, placed to left ; pre-septal funnel with ciliated nephrostome in one segment, and post-septal with a brown, fusiform ampulla followed by a coiled duct partly

passing through gland tissue and opening ventro-laterally in next segment.

Budding absent ; fragmentation occurs. A worm kept in a tube of water for a day fragmented into 2, each fragment with 29 segments. Posterior fragment regenerated 5 head segments and prostomium and anterior fragment regenerated several hind segments.

Sexual worms abundant in winter. In January 1954 several sexual worms were collected. Testes and ovaries develop first in V and VI, after production of sex cells they are resorbed. Clitellum develops later from ½ V-VII (2½ segments). Sperm- and ovi-sac extend to XII and XIII respectively when full, the former within the latter. Sperm-funnels cup-shaped with ciliated margins, open in sperm-sac. Vas deferens thin, coiled, and open into large ovoid atria in VI. Atrial ejaculatory ducts short and open to exterior ventro-laterally in a shallow depression by the side of penial setae in VI. Penial setae (Fig. 27 F) 3-5 per bundle, 63 $\mu$ long. Female funnels not observed. Spermathecae ovoid, thin-walled, 1½-2 times as long as broad, ectal ducts short and open in front of ventral bundles of V. Clitellum begins to form before male funnels and spermathecae are fully formed, but only after sperm- and ovi-sac are fully developed.

1 (living) = 4-12 mm.; d (living) = 0.2 mm.; s = 23-86 ; n = 29 (in one worm).

Lengths of longest setae in $\mu$ and position of nodulus in the ratio D : P ::

| | II | III | IV | V | VI | VII | VIII | IX | X |
|---|---|---|---|---|---|---|---|---|---|
| Hair | — | — | — | — | 140 | 157.5 | 157.5 | 164 | 140 |
| Needle | — | — | — | — | 59.5 | 63 | 63 | 63 | 63 |
| | | | | | 5:12 | 6:12 | 6:12 | 6:12 | 6:12 |
| V. seta | 63 | 59.5 | 56 | 56 | 56 | 52.5 | 52.5 | 52.5 | 52.5 |
| | 9:9 | 9:8 | 9:7 | 8:8 | 7:9 | 7:8 | 7:8 | 7:8 | 7:8 |

*Distribution in Indian sub-continent :* Gwalior (central India). Now recorded from Cuddapah and Kakinada (S. India).

*Habits* : Worms live in algae and aquatic vegetation; do not construct tubes. Swim by transverse undulations.

*Commensals :* Number of sessile Vorticellids are found attached to setae of these worms.

*Parasites :* Holotrichous astomatous Ciliates akin to *Anoplophrya* are seen in the gut of some worms.

*Remarks :* The descriptions of *Allonais gwaliorensis* available in the literature are incomplete. Details regarding the blood colour, vascular system, lacking in the descriptions, are here included. Penial setae are present, 3-5 per bundle, and are similar in shape to those of *Nais variabilis*. Chen (1940) seems to have overlooked them. Stomach, stated to be absent by the previous authors, is also present.

(*To be continued*)